CEDAR HILLS Hydrology

TECHNICAL D[illegible] AND RESEARCH CENTER
KING COUNTY DEPARTMENT OF
NATURAL RESOURCES AND PARKS

HYDROLOGIC DATA REVIEW

for

King County Solid Waste Division

as

Subcontractor to

Harper Owes

7/20/88

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PURPOSES

1. Review previous hydrologic studies and evaluate and critique without duplicating pre-existing efforts.

2. Evaluate leachate hydrology in terms of quantity, flow variation, and geographic distribution in order to provide flow related Design Criteria for Leachate Treatment Design.

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OBJECTIVES

- Identify factors controlling leachate flow:
  - percolation boundaries
  - seepage to surface
  - collection system interfaces
  - mounding effects
  - flow and pumping through leachate lines.
- Quantify flow magnitudes and variation of leachate.
- Assess chemical characteristics and variation of leachate.

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METHODOLOGY

- **Review exisiting reports**

  Existing Area Report, Sweet, Edwards & Associates, Inc. December 1985.

  Site Development Plan, CH2M Hill, December 1987.

  Operations Manual, CH2M Hill, May 1988.

  Ground Water Geology/Quality Investigations for the Cedar Hills Regional Landfill, R. W. Beck and Associates, Sweet, Edwards, & Assoc. Dec. 1984

  Existing Leachate Interceptor and Collection Facilities Map, Harper Owes, July 1985.

  Boring Logs, Sweet, Edwards & Associates, 1983-1986.

- **Review and Analyze Rain Gauge, Flow Recorder and Pump Operation Data.**

  Harper Owes *Lotus 1-2-3 database.*

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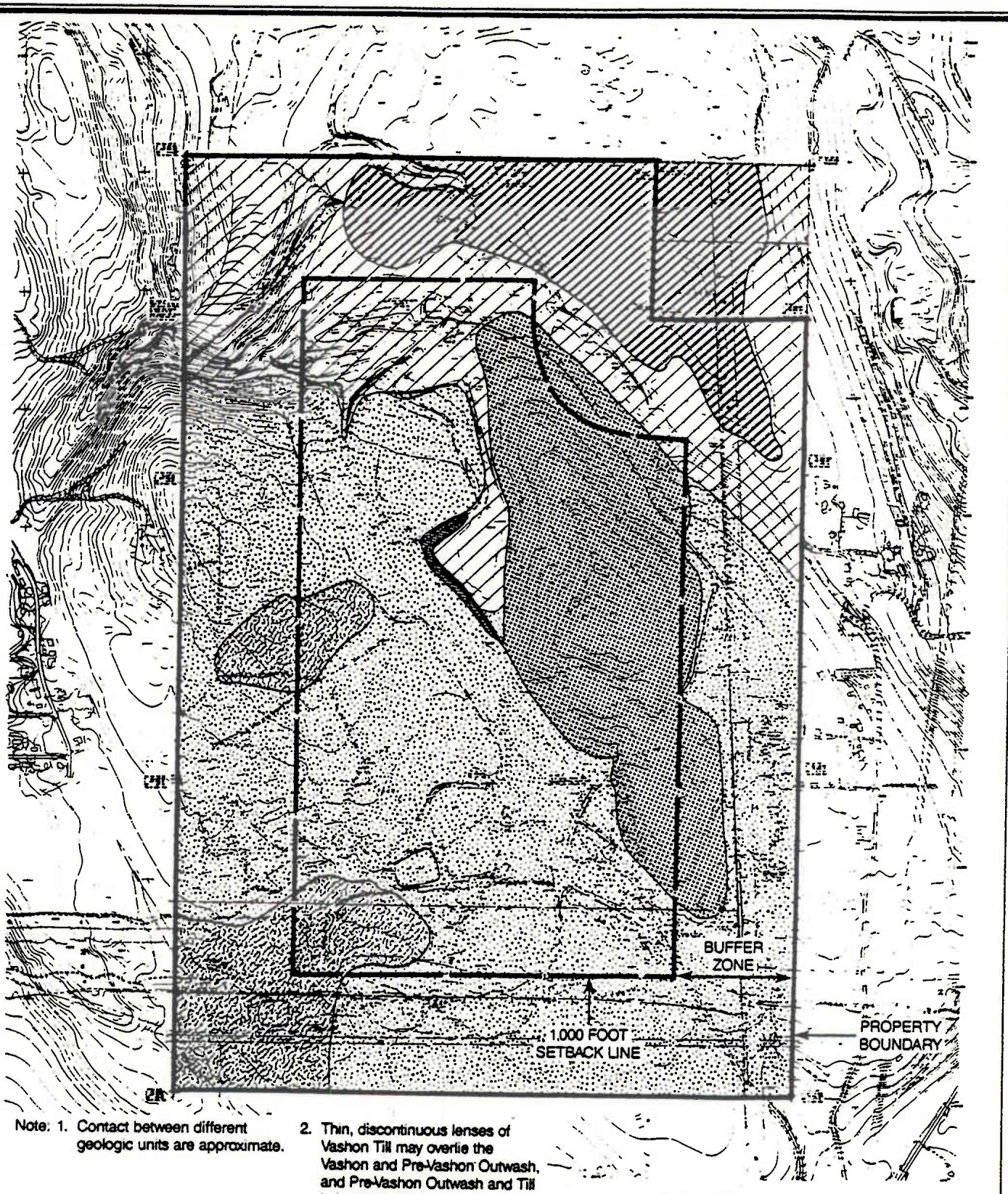

Note: 1. Contact between different geologic units are approximate.

2. Thin, discontinuous lenses of Vashon Till may overlie the Vashon and Pre-Vashon Outwash, and Pre-Vashon Outwash and Till in isolated areas.

Source; Sweet, Edwards & Associates, 1985.

N

SCALE IN FEET

0 800 1,600

- Vashon and Pre-Vashon Outwash
- Pre-Vashon Outwash and Till
- Interbedded Silt/Sand Unit Within Vashon Till
- Geologic Contact
- Vashon Till
- Existing Landfill
- Vashon Recessional Outwash

Figure 5. Surficial geologic map of the Cedar Hills Regional Landfill.

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What is the Groundwater Flow Direction in the Deep Aquifer?

- North EAST or North WEST?
- Has the flow direction been refined further?
- How does flow change as production wells are pumped?
- Offsite wells being monitored are to the NE, E, SE.
- Could Wells # 18 and # 22 (Parametrix, 1986) be sampled?

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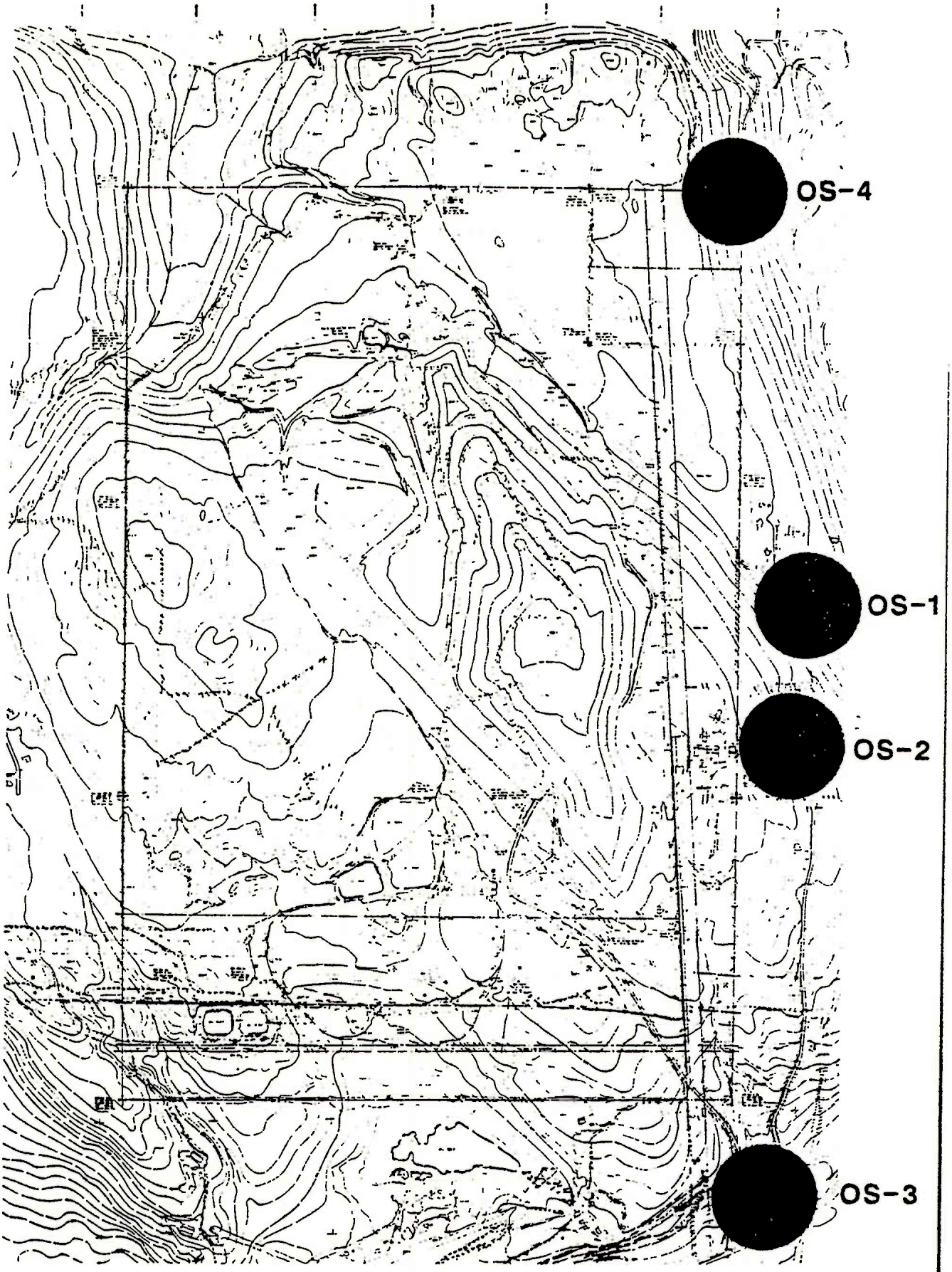

RECOMMEDED OFF-SITE WELLS TO BE MONITORED

PARAMETRIX, 1986

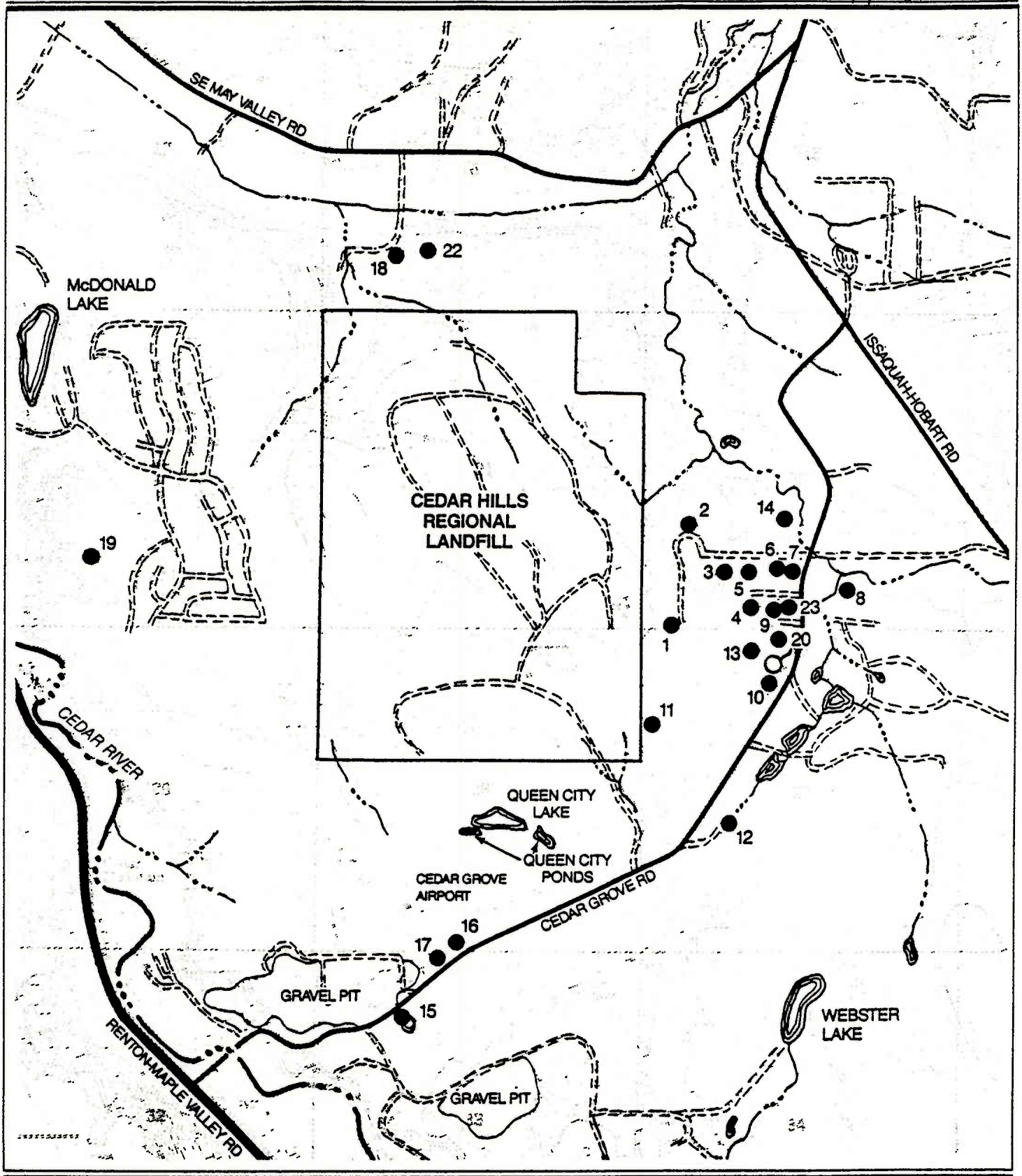

Figure 7.
Existing well locations in the vicinity of the Cedar Hills Regional Landfill.

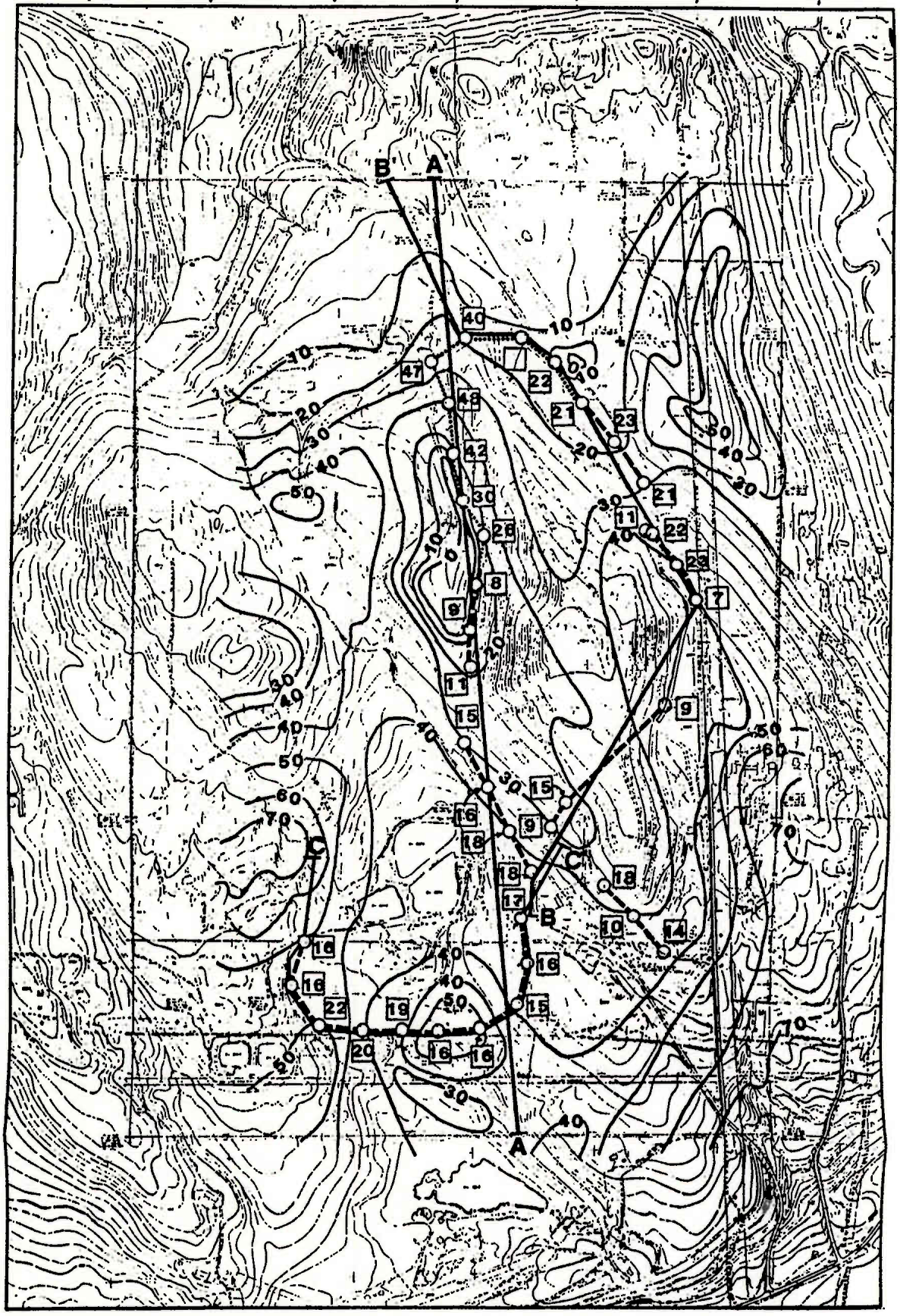

FIGURE 2

CEDAR HILLS SANITARY LANDFILL

Isopach map for the Vashon till, including weathered till. Diagram includes position of leachate collection trench (depth) and location of the geologic sections.

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Hydraulic Conductivity Measurements

Refuse Pile

5.1×10^{-3} to 5.1×10^{-4} cm/sec
(Sweet-Edwards, 1988)

Vashon Till

(undifferentiated) **3.6×10^{-3} to 5.1×10^{-6} cm/sec**
(Sweet-Edwards, 1984)

(weathered) **2×10^{-6} cm/sec** (CH2M-Hill, 1985)

(unweathered) **10^{-6} to 10^{-7} cm/sec** (Converse, 1980)

5×10^{-5} to 7×10^{-8} cm/sec
(CH2M-Hill, 1985)

Stratified Drift

9.1×10^{-3} cm/sec to 1.2×10^{-5} cm/sec
(Sweet-Edwards,1984)

Outwash Deposits

1.4×10^{-1} cm/sec to 1.9×10^{-6} cm/sec
(Sweet-Edwards)

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Leachate Head Reduction Study

Limitations of the Study:

- **Mound Morphology**
  - **Original topographic surface**
  - **Piezometric surface**
- **Spatial Variability Parameters Uncertain**
  - **K_V vs. K_H, storativity**
  - **Stratigraphy**
  - **Thickness of leachate**
  - **Wells are aligned N-S**
- **Physical properties of leachate vs. water**
- **Additional pump testing would be beneficial**

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Leachate Head Reduction Study

Analysis of the Conclusions:

Three Design Options

- **7 horizontal drains**
- **25 vertical wells**
- **Combination of wells and drains**

Sweet-Edwards considered the effectiveness, cost, and feasibility of all options. Conclusions are reasonable based on assumptions and limitations of the data. However, more data are needed to evaluate and design the system.

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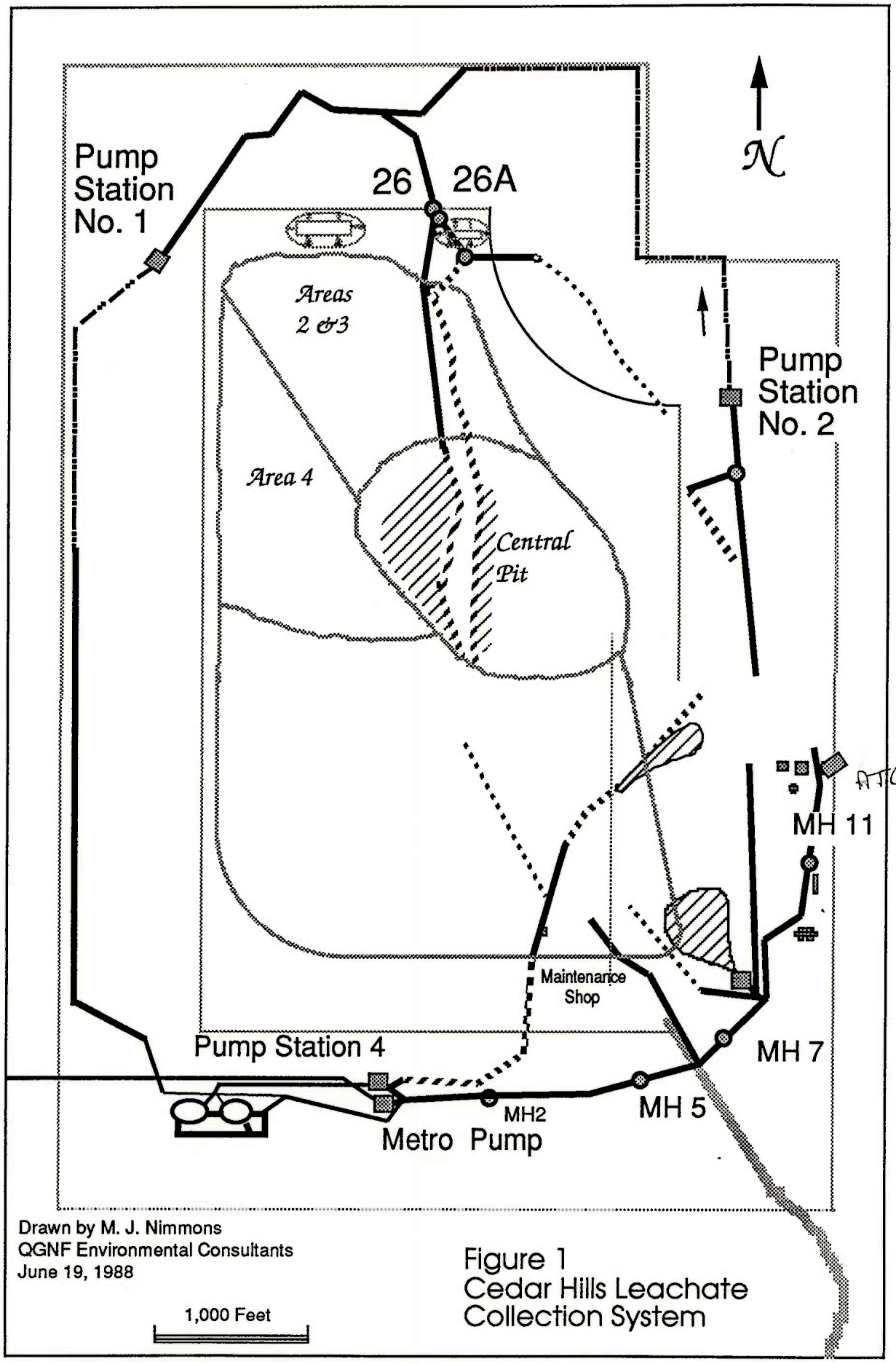

Drawn by M. J. Nimmons
QGNF Environmental Consultants
June 19, 1988

1,000 Feet

Figure 1
Cedar Hills Leachate
Collection System

Data Limitations

- Though data collected, precipitation reports not available after March 30, 1988.
- Flow Recorder Data for Manholes available from Dec. 16, 1987 thru March 24, 1988.
- Man Hole 2 has NO weir, therefore flow monitoring data not valid.

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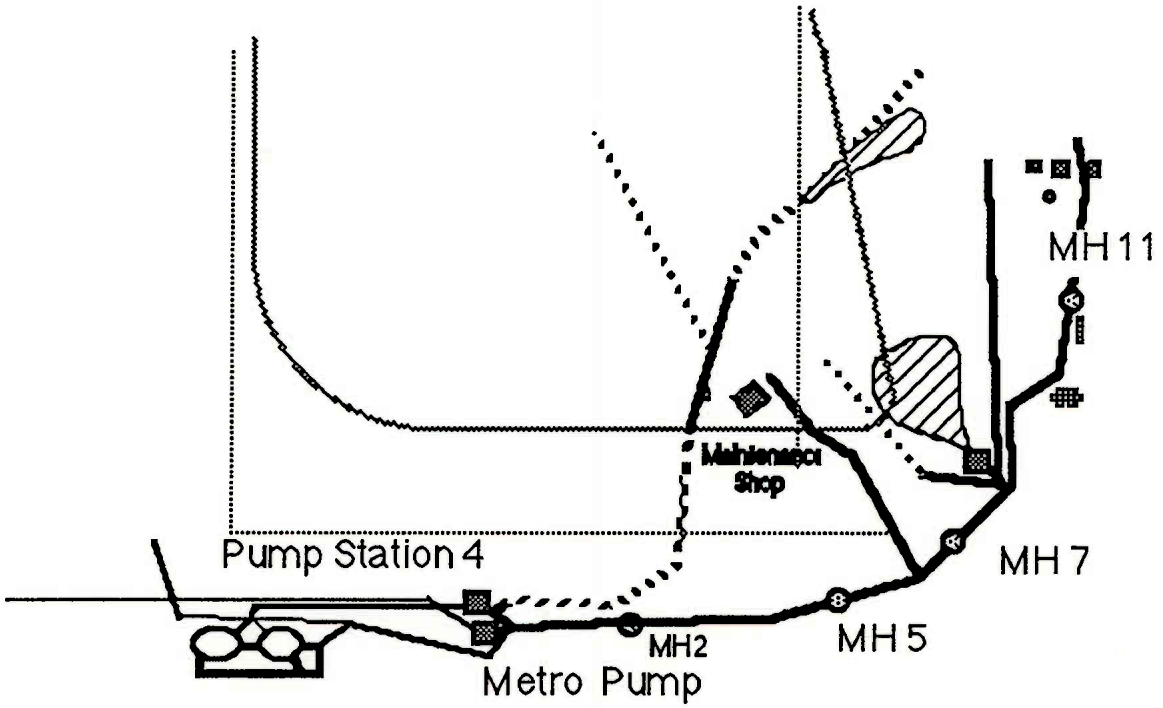
Focus on South Leachate Collection Area



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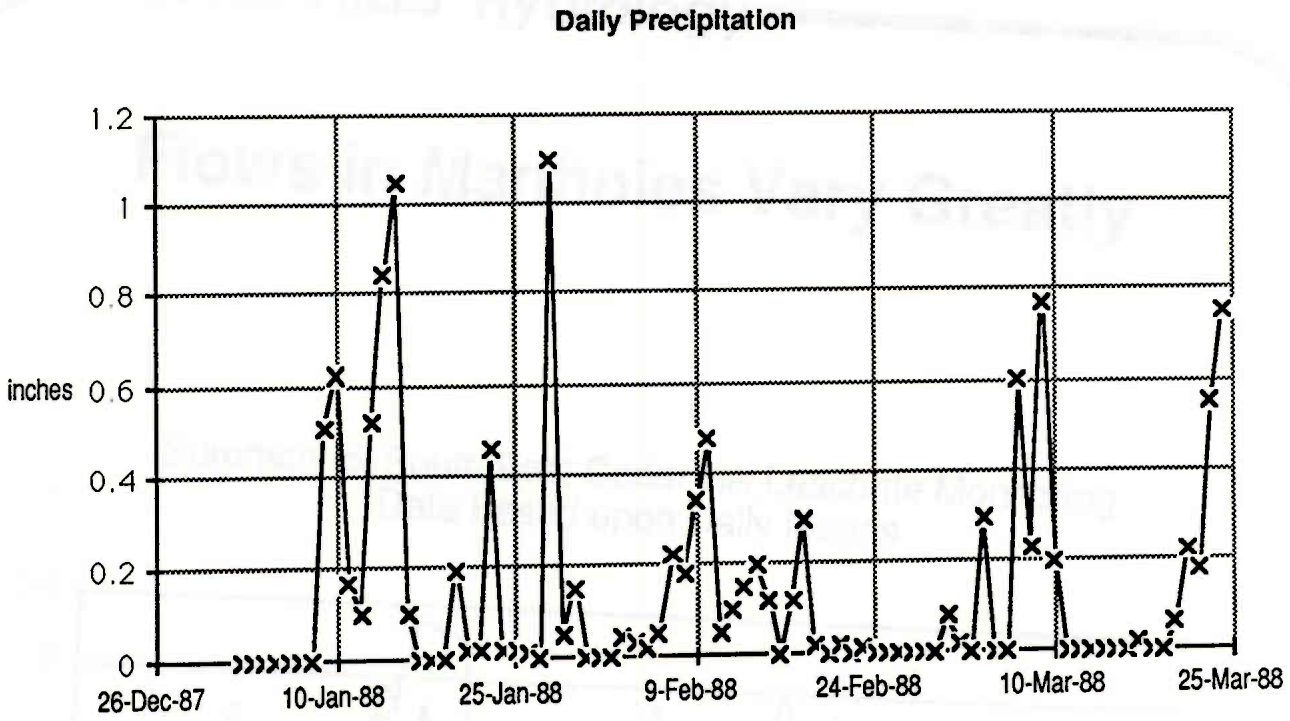
Precipitation Record



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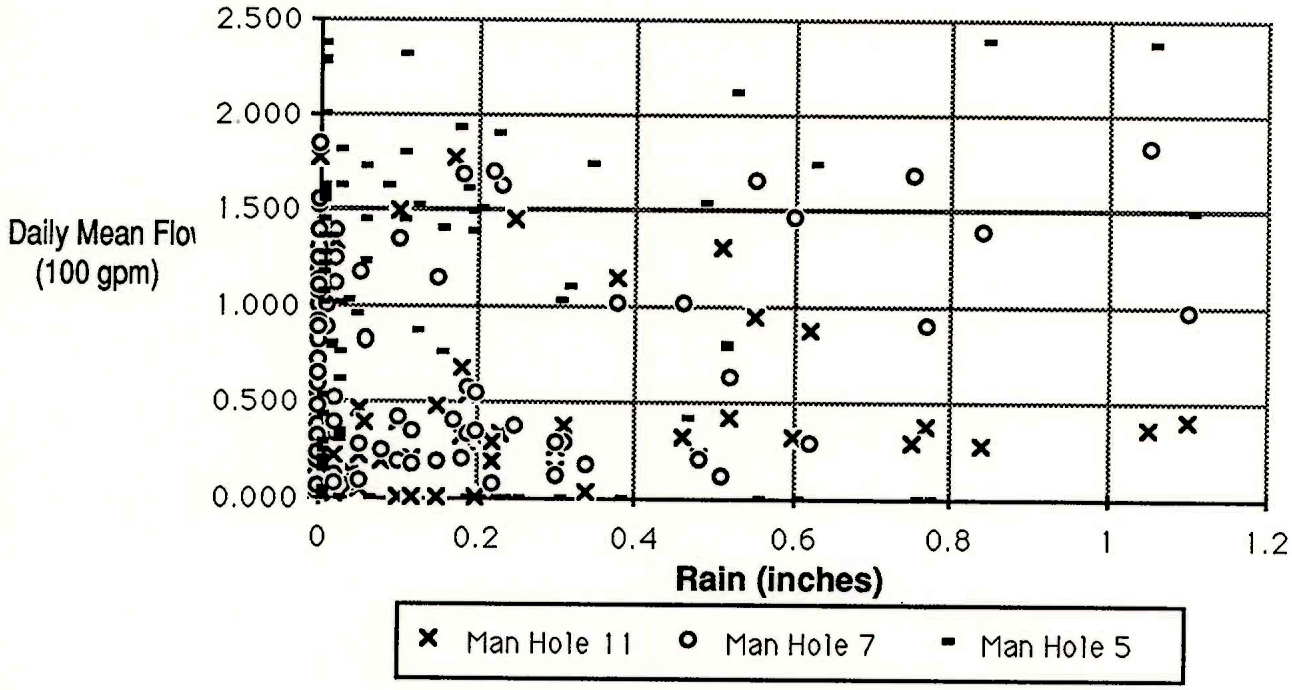
Does Leachate Flow Correlate with Rainfall?



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Examine Factors Which Could Contribute to Variation

knew all this 4 mos ago.

- **Different Bubbler Tube after February 3, 1988.**
- **Bubbler Tube Fouling - Readings immediately *before* cleaning may be different from readings *after* cleaning.**
- **Flows from Maintenance Facility and Alcohol Rehabilitation Center.**
- **Monitoring record may be <u>statistically</u> inadequate.**

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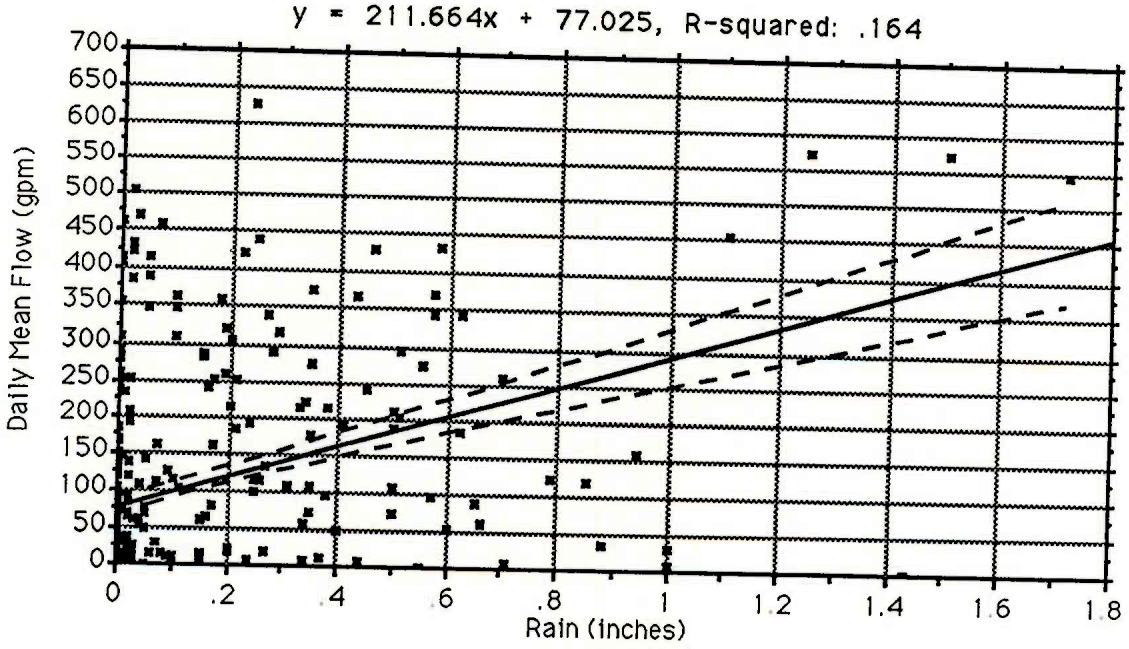
Pump Station 1 flows are slightly correlated to rainfall.



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Use T-Test to Determine whether Monitoring Record Is Affected by Changes

T-Test

One	Two
1.103	0.079
0.882	0.191
0.063	0.230
0.917	0.083
0.248	0.121
0.055	0.595
0.350	0.289
0.133	0.333
0.176	0.376
0.181	0.198
0.206	0.192
0.282	0.345
0.831	0.068
0.408	0.057
0.079	0.086

One	Two	
0.39	0.22	mean
0.13	0.02	variance
15	15	number of samples

t= 1.79025428675
df= 28
At 5 % , t table= 2.048
At 1 % , t table= 2.763

One is MH-7 flow 3-days BEFORE Servicing March, Feb
Two is MH-7 flow 3-days AFTER Servicing March, Feb

With 99% confidence,the two populations are the same. TRUE
With 95% confidence, the two populations are the same. TRUE

Degrees of Freedom	t at 0.05		t at 0.01
1	12.706	1	63.657
2	4.303	2	9.925
3	3.182	3	5.841

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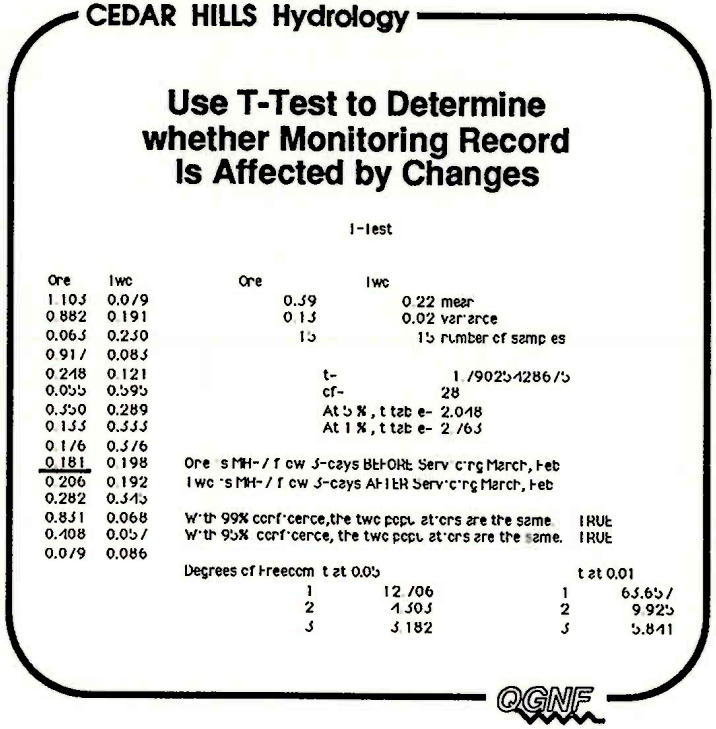

t-Test Requirements

1 The two groups are independent.

2.Measurement is at least at the interval level.

3. The populations are normally distributed.

> "Severe departure from normality seems to have little effect on the conclusions when sample sizes are 30 or more." Sharp, *Statistics for the Social Sciences*, p.275.

4. The populations have the same variances.

5. The samples are drawn at random.

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T-Test Results

- Precipitation BEFORE and AFTER Bubbler Port Change (Feb. 3, 1988)------> SAME Population.
- MH-11 flow BEFORE and AFTER Bubbler Port Change------> DIFFERENT Population.
- MH-7 flow BEFORE and AFTER Bubbler Port Change-------> DIFFERENT Populaton.
- MH-5 flow BEFORE and AFTER Bubbler Port Change--------> SAME Population with 99 and 95% Confidence.

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Does Flow Monitor Servicing Make a Difference?

Possibly so but not enough data to say conclusively.

MH-7 Flows 3 days before servicing and 3 days after servicing in February, March of 1988.

T-Test-------> Populations are the Same (95% and 99% confidence)

	Before	After
n	15	15
mean	0.39	0.22
variance	0.13	0.02

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